Experimental Analysis of Evaporation time for NB85 W15 with CNT25

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Abstract— The present study attempts to improve evaporation characteristics of emulsified biodiesel with the addition of carbon base additives. In this experiment evaporation time of various droplets are measure on hot surface of stainless steel plate. The drop of fuel samples dropped on hot surface of stainless steel from fixed height and it is done in atmospheric condition. The use of petrol and diesel is so expensive and available in less quantity so here I use neem biodiesel alternating fuel to the petrol and diesel. Experiment is carried out with emulsified neem biodiesel NB85 W15 (85% neem biodiesel and 15% water) added to the CNT25 additives (25 mg/lit multiwall carbon nanotube) on the hot surface of plate, having temperature range of 300-500 ºC. At maximum temperature with the addition of additives in emulsified biodiesel I got better evaporation rate compare to pure biodiesel.

Keywords— Additives, emulsified biodiesel.

INTRODUCTION

Now a days worldwide petroleum consumption is so increase, the petroleum is a finite source for fuel that is rapidly becoming more expensive. Biodiesel is an eco-friendly alternative fuel to the petrol and diesel which is made by esterification and transesterification of vegetable oils and animal fat. With the use of biodiesel in diesel engine particulate matter, hydrocarbons, and carbon monoxide emissions are reduced in the environment. Water emulsion in biodiesel i.e emulsified biodiesel fuel play an important role in liquid fuel engines. Because of water emulsion in biodiesel, surface area of that fuel is increases which is responsible for better evaporation rate. The emulsified biodiesel use in diesel engine improve brake thermal efficiency and reduces exhaust emission in the atmosphere. The various types of additives use in biodiesel fuel or blend of diesel and biodiesel fuel which increases the ignition probability of fuel. Use of these additives in biodiesel also increases the thermal efficiency of engine and reduces exhaust emission in the atmosphere. The selection of additives for the biodiesel fuel is depends additive solubility, viscosity of the fuel blend, flash point of the fuel blend, solubility of water in the blend and water partitioning of the additive.

Rakhi N. Mehta et al. [1] studied on burning characteristics, engine performance and emission parameters of a single-cylinder Compression Ignition (CI) engine using nanofuels. Nanofuels use in CI engine are formulated by nanoparticles such as aluminum (A1), iron (F1) and boron (B1) in base diesel. They use three nanoparticles (A1), (F1), and (B1), in base diesel to increase evaporation rate and reduce ignition delay. They found that nanofuels A1, B1 and F1 use in base diesel, increased evaporation rates and ignition time reduce to at 0.2 s as compared to diesel (1.2 s). At maximum load condition lower ignition delay, and increases brake thermal efficiency was occure as compare to pure diesel.

Himanshu Tyagi et al.[2] studied on the effect of addition of aluminum and aluminum oxide nanoparticles in diesel to improve ignition properties of diesel. They experiment were conducted on top surface of heated hot plate in which they used different types of fuel mixtures were both particle size (15 and 50 nm) and the volume fraction (0%, 0.1%, and 0.5%) of nanoparticles are added to diesel were varied. At identical condition, various droplets were dropped on the top surface of hot plate from a fixed height, for each type of fuel mixture. Base on the ignition of number of droplets, the ignition probability of that fuel were recorded. These experiments were repeated at various temperatures over the range of 688-768 ºC. Result shows that the ignition probability was higher for the fuel mixtures that contained nanoparticles compare to pure diesel.

M. Abu-Zaid., [3] they investigated the ignition time rate of a single droplet, on hot surface of stainless-steel and with emulsified diesel and emulsified kerosene. At atmospheric pressure experiment can be performed, concentrations of water by volume are 10, 20, 30, and 40%. Range of wall temperature from 110–480 ºC, to protect the whole spectrum of heat transfer characteristics. Result shows that the curves of emulsified evaporation is same as the pure liquid. There is a significant difference in evaporation time, total evaporation time required for the emulsified droplets is lower compare to
pure diesel and kerosene fuels. When the initial concentration of water increases required evaporation time was decreases. As the initial concentration of water increase, value of the critical surface temperature decreases because of maximum heat transfer. Evaporation time require was higher for diesel and kerosene droplet.

Irfan Javed et al.[4] Studied on the evaporation characteristics of n-heptane droplets with varying composition of aluminum nanoparticles hanging at a silicon carbide fiber. This experimental study was carried out at several temperatures (100–600 °C) under normal condition. With the addition of aluminum nanoparticles, the phenomenon of bubble formation in stabilized heptane droplets is reduced. For all aluminum nanoparticles suspensions; regardless of their concentrations, from the temperature of 100 to 300 °C the evaporation rate obtained was lower than pure heptane droplets, but above 400 °C evaporation rate of n-heptane droplets is higher with varying composition of aluminum nanoparticles compare to pure heptane droplets. Result shows that the at maximum temperature with varying concentration of aluminum nanoparticles evaporation rate of n-heptane is higher as compare to pure heptanes.

Kang-Shin Chen et al.,[5] They studied on saving energy and reducing pollution by use of emulified palm-biodiesel blends with bio-solution additive. For saving energy and reduce emission in diesel engine consumer use advance biodiesel, emulified diesel and chemical additives in biodiesel. Experimental result shows that with the use of emulified palm-biodiesel with bio-solution additives there was saving in energy and reduction in emissions of both polycyclic aromatic hydrocarbons and particulate matter from diesel engines. They used E16P20 fuel (16 vol% bio-solution + 20 vol% palm-biodiesel + 64 vol% P0, an additional 1 vol% surfactant) in diesel engine which saved 12.4% fuel consumption and lowered the emissions of particulate matter by 90.1%, total polycyclic aromatic hydrocarbons by 69.3% comparing with pure diesel fuel. Emulified palm-biodiesel with bio-solution additives is an alternative and clean fuel which enhance the combustion efficiency

Biplab K. Debnath et al., [6] studied on Adjusting the operating characteristics to improve the performance of an emulified palm oil methyl ester run diesel engine. Emulized fuel is alternative fuel to the diesel, and water in diesel emulsion is mostly used. Due to water use in emulsion micro-explosion is occur which reduces emission in the atmosphere. Oxygenated biodiesel in engine emits high NOx than diesel. The investigation of this work is to find performance, combustion and emission characteristics of emulified biodiesel in a diesel engine at an elevated compression ratio and retarded injection timing. With the combination of CR-IT objective of this experiment to achieve a faster combustion, lower ignition delay, improved performance and emission characteristics. In this biodiesel use is palm oil methyl ester and emulsion is tested on diesel engine at compression ratio = 18 and injection timing = 20° BTDC. Result shows that with emulified palm oil methyl ester there is reduction in carboniferous emission, NOx formation and the hazardous emissions created by oxygenated biodiesel.

A.M. Ashraful et al.,[7] they evaluated the effect of anti-corrosion additives such as 8% and 16% (vol.%) palm olein oil (PO) with ordinary diesel (OD) fuel on engine operation, emission behavior, engine part wear, and lubrication characteristics. The experimental study was taken on 4-cylinder and 4-stroke IDI diesel engine at different engine speed ranging from 1200 to 2800 RPM with 30% throttle setting under full load condition. Result shows that at 2000 rpm the POD8A (0.2% Additive + 8% PO + 92% OD) and POD16A (0.2% Additive + 16% PO + 84% OD) blended fuels produced 0.5% and 0.51% higher brake power as well as 1.45% and 1.25% higher torque than same blends without additive. Effect of anti-corrosive additives in engine enhancing the engine performance as such additive helps in timely ignition for complete burn in the combustion chamber. By using POD8A and POD16A blended fuel there is a reduction in CO emissions by 11% and 6.6% and NOx emission by 2.5% and 1.09%, respectively in compared with OD fuel, also for blended fuel HC emission is not higher than the ordinary diesel.

PREPERATION OF FUEL SAMPLES

1) Pretreatment
Neem oil first filtered to remove solid particles and then heated at 110 °C for 30 min to remove moisture, wax, carbon residue.

2) Esterification
Neem oil is heated up to 50 °C, 0.5% Sulphuric acid and 13% Methyl alcohol added to heated neem oil then stirring process is done at 50-60 °C for 90 min to form esterified oil.

3) Transterification
In this process 1% Potassium hydroxide added to the 13% Methyl alcohol and stirring process is done at 700 rpm for 20 min. to form methoxide.

4) Mixing
In this esterified oil and methoxide are mix together, and stirred it at 60-65 °C, at 700 rpm for 70 min.
5] Cooling
Cooled the above mixture and then separated biodiesel and glycerin in different beaker.

6] Alcohol Removal
Alcohol is removed by distillation process.

From the above process I got pure neem biodiesel from neem oil.

Emulsification
In this experiment emulsification of water in biodiesel fuel done with stirring process. Stirring process done with the help of magnetic stirrer. Here I used 15% water for emulsification in 85% biodiesel. This stirring process carried out for 90 min at 700 rpm for better emulsification.

EXPERIMENTAL SETUP

The experimental setup for measuring the evaporation rate consists of stainless steel plate having a length of 80 mm. At the center of this plate there is a small curvature to assured that the drop should not be scattered when it draws from the tube which is mounted at certain height and holded by holding stand. The distance between tip of tube and surface of plate is 25 mm.

Schematic diagram of experimental apparatus.

Experimental set up consist of electrical heater which is fixed with stainless steel plate, automatic temperature controller, thermocouple, burret with droper. Experiment is done on top surface of the hoted steel plate, and at the temperature range of 300-750°C with an interval of 50°C.

EXPERIMENTAL PROCEDURE

1) At first only 50 drops of pure diesel is tested on the surface of hot stainless steel plate by dropping the drop of the diesel through the tube at several temperatures started from 300 °C to 650 °C with increment of 50 °C.
2) Then draw a first drop of diesel on the plate surface and start the digital stopwatch as the drop, dropped on the hot surface of plate and stops it as drop evaporated completely and note down the time.
3) Repeat above procedure for remaining 49 drops.
4) Similar process can be done for emulsified biodiesel at several temperature started from 400 °C to 750 °C at a interval of 50 °C.
5) Then emulsified biodiesel is mix with the respective additive with concentration of 25mg/liter to check evaporation rate.

RESULT AND DISCUSSION

Experiment was conducted on starting temperature of 300 to 750 °C at an interval of 50 °C. In this experiment vaporization of fuel emulsion droplet dropped on hot surface of steel plate has been investigated, and evaporation time of that droplet has measured with the help of stopwatch. Due to low boiling point of water emulsified biodiesel have high evaporation rate than the pure biodiesel, that’s why I use emulsified biodiesel instead of pure biodiesel. Evaporation rate of emulsified neem biodiesel (85% neem biodiesel and 15% water) added with 25 mg/liter multiwall carbon nanotube was carried out on hot surface of stainless steel plate. Properties such as flash point test and viscosity test can be tested on NB85 W15 with CNT 25mg/liter. The values of properties of this fuel sample shows it have better ignition probability.

<table>
<thead>
<tr>
<th>properties</th>
<th>diesel</th>
<th>NB85W15 CNT25</th>
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<tbody>
<tr>
<td>Viscosity(centistokes)</td>
<td>5.5</td>
<td>5.17</td>
</tr>
<tr>
<td>Flash point (°C)</td>
<td>73</td>
<td>76</td>
</tr>
</tbody>
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Following figure shows the evaporation rate of pure diesel and emulsified biodiesel with 25 mg/liter multiwall carbon nanotube.

![Figure 1. Variation of Evaporation rate with temperature for pure diesel](image-url)
Figure 2. Variation of Evaporation rate with temperature for emulsified biodiesel + 25 mg CN

Fig 1. Shows the evaporation rate of pure diesel with varying temperature. In this evaporation rate increase as the increase in temperature. At maximum temperature evaporation rate of diesel is higher. Fig 2. Shows the evaporation rate of NB85W15 with CNT25. In this increase in temperature evaporation rate also increase. Evaporation rate is higher at higher temperature. Evaporation rate of NB85W15 CNT25 is higher compare to pure biodiesel because of multiwall carbon nanotube are added to the emulsified biodiesel. As we added the multiwall carbon nanotube in emulsified neem biodiesel ignition probability of that fuel increases that’s why it gives better evaporation rate at maximum temperature.

Compare to diesel fuel evaporation rate of NB85 W15 CNT25 not so much different, so we can use NB85 W15 CNT25 fuel sample instead of pure diesel because of it having more advantages. The use of NB85 W15 CNT25 fuel sample in diesel engine increases brake thermal efficiency and reduces exhaust emission in the atmosphere.

CONCLUSION

Due to emulsified neem biodiesel in the diesel engine high mixture of air and fuel is occur which is responsible for better ignition, which reduces the exhaust emission in the atmosphere. Water emulsion in neem biodiesel can improve the brake efficiency, also significantly reduce the formation of nitrogen monoxide, soot formation, hydrocarbons, and particulate matter in diesel engines. Use of multiwall carbon nanotube additives in emulsified neem biodiesel fuel increases ignition probability of that fuel and gives higher evaporation rate. These type of additives use in emulsified neem biodiesel fuel also increase thermal efficiency of engine and reduces exhaust emission in the atmosphere.

REFERENCES


